

Application No.: 10/605,990

Docket No.: BUR920020122US1
21806-00151-US1**AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS

1. (Currently amended) A method for performing an electromigration check for conductors with alternating current flow adjacent to conductors with direct current flow in an integrated circuit comprising:

determining resistances R_{WRE} and a capacitance matrix C for the integrated circuit;

converting the capacitance matrix C into a thermal conductance matrix G ;

determining temperature differences ΔT_{ni} between conductors from thermal conductances G_{thi} of the thermal conductance matrix G ;

approximating power flow P_n into conductors with direct current flow due to adjacent conductors with alternating current flow in the integrated circuit from the temperature differences ΔT_{ni} between conductors and the thermal conductances G_{thi} ;

determining a power limit as a function of the maximum temperature difference ΔT_{MAX} that ensures reliability of the integrated circuit; and

performing the electromigration check by limiting power generated in the conductors with alternating current flow to less than the power limit,

wherein n and i are conductor numbers.

2. (Original) The method of claim 1, wherein the thermal conductance matrix G is determined from the product of the capacitance matrix C and a scalar factor F and the scalar factor is given by a ratio of thermal conductivity κ to permittivity ϵ .

3. (Original) The method of claim 1, wherein the power limit is given by the product of scalar factor F , the total capacitance C_{tot} and the maximum temperature difference ΔT_{MAX} .

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4. (Original) The method of claim 1, wherein the I_{RMS} value is determined by the expression $C_{load} * V_{dd} * \text{frequency} * \text{Switching factor}$.

5. (Original) The method of claim 1, wherein the thermal conductances G_{thi} are inputs for a circuit simulator that determines temperature differences between conductors ΔT_{ni} as outputs of the circuit simulator.

6. (Currently amended) The method of claim 1, wherein the capacitance matrix C and resistances R_{WIRE} are determined by using simulation and analysis tools that ~~at least~~ include capacitance/resistance extraction capabilities.

7. (Currently amended) A method for performing an electromigration check for conductors with alternating current flow adjacent to conductors with direct current flow comprising:

determining resistances R_{WIRE} and capacitances C_{ni} for conductors with alternating current flow and conductors with direct current flow;

converting the capacitances C_{ni} into thermal conductances G_{thi} ;

determining temperature differences ΔT_{ni} between conductors from the thermal conductances G_{thi} ;

approximating power flow P_n into conductors with direct current flow due to adjacent conductors with alternating current flow from the temperature differences ΔT_{ni} between conductors and thermal conductances G_{thi} ;

determining a power limit as a function of a maximum temperature difference ΔT_{MAX} for the conductors that ensures reliability of the ~~conductor~~ conductors; and

performing the electromigration check by limiting power generated in the conductors with alternating current flow to less than the power limit,

wherein n and i are conductor numbers.

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8. (Currently amended) The method of claim 7, wherein the thermal conductances G_{thi} are determined from the product of the capacitances C_{ni} and a ~~factor F~~ and the scalar factor F is given by a ratio of thermal conductivity κ to permittivity ϵ .
9. (Original) The method of claim 7, wherein the power limit is given by the product of scalar factor F, the total capacitance C_{ntot} and the maximum temperature difference ΔT_{MAX} .
10. (Original) The method of claim 7, wherein the I_{RMS} value is determined by the expression $C_{load} * V_{dd} * \text{frequency} * \text{Switching factor}$.
11. (Original) The method of claim 7, wherein the thermal conductances G_{thi} are inputs for a circuit simulator that determines temperature differences between conductors ΔT_{ni} as outputs of the circuit simulator.
12. (Original) The method of claim 7, wherein the capacitances C_{ni} and resistances R_{WIRE} are determined by using simulation and analysis tools that at least include capacitance/resistance extraction capabilities.
13. (Currently amended) A method for performing a check of local heating in a device comprising:
- determining resistances R_{WIRE} and at least one of capacitances C_{ni} and a capacitance matrix C for the device;
 - determining thermal conductances G_{thi} from the at least one of capacitances C_{ni} and a capacitance matrix C ;
 - setting a maximum temperature difference ΔT_{MAX} in accordance with electromigration requirements; determining a power limit $F * C_{ntot} * \Delta T_{MAX}$ as a function of the maximum temperature difference ΔT_{MAX} ;
 - checking ~~each interconnect conductor~~ conductor-conductors with an alternating current flow to determine if power generated $I_{RMS} * R_{WIRE}^2$ is less than the power limit $F * C_{ntot} * \Delta T_{MAX}$;

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indicating no local heating problem with an interconnect conductor when power generated $I_{RMS} * R_{WIRE}^2$ is less than the power limit $F * C_{ntot} * \Delta T_{MAX}$;

indicating a local heating problem exist with ~~current an~~ interconnect conductor when the power generated $I_{RMS} * R_{WIRE}^2$ is equal to or greater than the power limit $F * C_{ntot} * \Delta T_{MAX}$ and taking corrective action to reduce the power generated $I_{RMS} * R_{WIRE}^2$; and

continuing to check ~~each~~ interconnect ~~conductor~~ conductors with alternating current flow until all interconnect conductors have a value for power generated $I_{RMS} * R_{WIRE}^2$ less than the power limit $F * C_{ntot} * \Delta T_{MAX}$.

wherein n and i are conductor numbers, F is a scalar factor and C_{ntot} is a total capacitance.

14. (Currently amended) The method of claim 13, wherein the thermal conductances G_{thi} are determined from the product of the capacitances C_{ni} and a ~~factor F and the~~ scalar factor F is given by a ratio of thermal conductivity κ to permittivity ϵ .

15. (Currently amended) The method of claim 13, wherein the power limit is given by ~~the a~~ product of scalar factor F, the total capacitance C_{ntot} and the maximum temperature difference ΔT_{MAX} .

16. (Original) The method of claim 13, wherein the I_{RMS} value is determined by the expression $C_{load} * V_{dd} * \text{frequency} * \text{Switching factor}$.

17. (Currently amended) The method of claim 13, wherein said thermal conductances G_{thi} are inputs for a circuit simulator that determines temperature differences ΔT_{nt} as outputs of the circuit simulator.

18. (Currently amended) The method of claim 13, wherein the capacitances C_{ni} and resistances R_{WIRE} are determined by using simulation and analysis tools that ~~at least~~ include capacitance/resistance extraction capabilities.

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19. (Currently amended) A computer-readable medium having a plurality of computer executable instructions for causing a computer to perform an electromigration check for conductors with alternating current flow adjacent to conductors with direct current flow in an integrated circuit, the computer executable instructions comprising:

instructions for determining resistances R_{WIRE} and a capacitance matrix C for the integrated circuit;

instructions for converting the capacitance matrix C into a thermal conductance matrix G ;

instructions for determining temperature differences ΔT_{ni} between conductors from thermal conductances G_{thi} of the thermal conductance matrix G ;

instructions for approximating power flow P_n into conductors with direct current flow due to adjacent conductors with alternating current flow in the integrated circuit from the temperature differences ΔT_{ni} between conductors and the thermal conductances G_{thi} ;

instructions for determining a power limit as a function of the maximum temperature difference ΔT_{MAX} that ensures reliability of the integrated circuit; and perform

instructions for performing the electromigration check by limiting power generated in the conductors with alternating current flow to less than the power limit,

wherein n and i are conductor numbers.

20. (Currently amended) The ~~method~~ computer readable medium of claim 19, wherein the thermal conductance matrix G is determined from the product of the capacitance matrix C and a scalar factor F and the scalar factor is given by a ratio of thermal conductivity k to permittivity ϵ .

21. (Currently amended) The ~~method~~ computer readable medium of claim ~~[[1]]~~ 19, wherein the power limit is given by the ~~a~~ product of scalar factor F , the total capacitance C_{ntot} and the maximum temperature difference ΔT_{MAX} .

22. (Currently amended) The ~~method~~ computer readable medium of claim ~~[[1]]~~ 19, wherein the I_{RMS} value is determined by the expression: $C_{\text{load}} * V_{\text{dd}} * \text{frequency} * \text{Switching factor}$.

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23. (Currently amended) The ~~method~~ computer readable medium of claim ~~[[1]]~~ 19, wherein the thermal conductances G_{thi} are inputs for a circuit simulator that determines temperature differences between conductors ΔT_{ni} as outputs of the circuit simulator.